

# Evaluation of Continuous Diabetes Screening in a Hospital Outpatient Department

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THERE have been many diabetic screening projects sponsored by medical societies, government agencies, and voluntary health groups. Their results have varied greatly, depending on the test used and the characteristics of the population tested. In 1958 the late Dr. Walter Bierring, then director of the division of gerontology and chronic diseases, Iowa State Department of Health, began a project to screen adult hospital outpatients with a semi-automatic instrument measuring blood glucose to detect unknown diabetes. The project was continued for 3½ years at Broadlawns Polk County Hospital in Des Moines, Iowa. The screening was conducted by a technician and a clerk with only minimal professional guidance. Because the screenees' clinical records were available, it was felt that an evaluation of the records might reflect a more accurate picture of the characteristics of the population screened than is usually available in screening programs and indicate the value of screening such a population with this method both as to yield of new diagnoses and the number of those receiving therapeutic benefit. The results of the first 34½ months of this project are reviewed in this paper.

## Methods

Clinic outpatients were screened without regard as to when they had last eaten. Only patients who denied histories of diabetes or "sugar in their urine" and did not have diabetes mellitus as a diagnosis on their hospital record were screened. Outpatients more than 20 years old, all obstetric patients, new employees of the hospital, and, for the last 24 months, blood do-

nors at a community blood bank were screened. An attempt was also made to screen relatives of those who were found to be diabetics by the screening program.

The tests were done on a clinitron, an automatic machine for screening blood for sugar, which utilizes the Wilkerson-Heftmann blood sugar test (1). The initial screening was at a level of 130 mg./100 ml. Those screening positive were asked to return under fasting conditions and were rescreened at levels of 130 and 160 mg./100 ml. Those positive at 160 mg./100 ml. were considered diabetic and referred to the medical outpatient clinic for followup. Those who rescreened positive at 130 mg./100 ml. and negative at 160 mg./100 ml. were considered as potential diabetics, and glucose tolerance tests were performed on as many as possible. The final diagnosis was made by the physicians in the clinic. The outpatient department is staffed by house officers of the hospital and part-time attending physicians from the community.

An effort was made to rescreen at 6-month intervals all those who originally screened positive and rescreened negative. Each of these patients was sent a postcard every 6 months asking them to return for another test. Patients who screened negative and periodically returned to the clinic for other reasons were rescreened at approximately yearly intervals whenever possible.

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Quarterly reports of the results were forwarded to the Division of Chronic Diseases, Public Health Service, through the Iowa State Department of Health. Ninety-three presumptive diabetics were screened by the program and included as positives in these quarterly reports. Hospital records of 54 of the 93 were reviewed.

## Results

From November 15, 1958, through September 30, 1961, 7,164 persons were screened. Of these, 926 had family histories of diabetes. Following are the various groups of persons screened at Broadlawns Polk County Hospital.

	No diabetes history	Diabetes history
Clinic patients.....	3,781	689
Relatives of diabetics found by screening.....		76
Hospital employees.....	297	74
Blood donors.....	2,160	87
Total.....	6,238	926

Table 1 shows the age, sex, and ethnic group distribution of those tested. About 82 percent

were white. Of the nonwhite group, 95 percent were Negro and the remaining Spanish American and oriental. The majority of those screened, about 60 percent, were under age 45.

Table 2 shows the results as reported to the Public Health Service. One hundred seventy-six, or 2.5 percent, screened positive, and 22 did not return for rescreening. Of the 154 who did return, 77, or 1.07 percent, rescreened positive and were eventually diagnosed and reported as diabetics. Seventy-seven rescreened as negative. As shown in table 2, another 10 of these 77 were eventually diagnosed as diabetics after from one to three 6-month retests. Of those who initially screened negative, 697 were again tested at a future date. From this group six more diabetics were diagnosed after being retested once. A total of 93 persons were diagnosed as diabetics and were reported, or 1.3 percent of the population screened.

Table 3 shows the results of the first screening as reported to the Public Health Service. The percentage found diabetic was 1.07, with the yield in the females screened almost twice that of the males and the yield in the population with a family history of diabetes two to

**Table 1. Persons screened for diabetes at Broadlawns Polk County Hospital, Des Moines, Iowa, by age group, sex, and ethnic group, Nov. 15, 1958–Sept. 30, 1961**

Age group (years)	Male			Female		
	Total	White	Non-white	Total	White	Non-white
No family history of diabetes						
Total.....	3,326	2,954	372	2,912	2,212	700
Under 20.....	94	85	9	114	97	17
20-44.....	1,754	1,539	215	1,764	1,282	482
45-64.....	1,006	916	90	609	505	104
65-74.....	230	200	30	283	215	68
75-84.....	201	179	22	97	72	25
85 and over.....	41	35	6	45	41	4
Family history of diabetes						
Total.....	275	238	37	651	500	151
Under 20.....	19	19	0	28	23	5
20-44.....	149	124	25	413	315	98
45-64.....	69	61	8	122	93	29
65-74.....	24	21	3	40	35	5
75-84.....	10	10	0	42	28	14
85 and over.....	4	3	1	6	6	0

three times that of those without a family history of diabetes.

The highest percentage of diabetics was

**Table 2. Results of diabetic screening and re-screening as reported to the Public Health Service, Nov. 15, 1958–Sept. 30, 1961**

Tests	Total persons tested	Test results		Diabetics re-reported
		Patients negative	Patients positive	
Initial screening-----	7, 164	6, 988	<sup>1</sup> 176	-----
Initial positives rescreened-----	154	77	77	77
Retests of initial positives who rescreened negative-----	67			-----
One 6-month retest-----		12	4	4
Two 6-month retests-----		12	4	4
Three 6-month retests-----		6	2	2
Four 6-month retests-----		3		
Retests of initial negatives-----	697			-----
One retest-----		626	<sup>2</sup> 17	6
Two retests-----		49		
Three retests-----		2		
Four retests-----		3		

<sup>1</sup> 22 persons did not return for rescreening.

<sup>2</sup> 11 of these later rescreened negative.

found among clinic patients. If retests are included, a total of 88 clinic patients (2 percent) were eventually diagnosed as diabetics. Diabetics reported after the initial screening, according to source, were these.

	Number screened	Diabetics reported	
		Number	Percent
Clinic patients-----	4, 470	73	1. 6
Hospital employees---	371	0	. 0
Blood donors-----	2, 247	3	. 13
Relative of diabetic found in screening--	76	1	1. 3

If one looks at the results of the screening by age group, the yield increases with age, from 0.39 percent under age 45 to 1.93 percent in the age group 45–64, to 4.0 percent over age 65 (table 4).

Hospital records were reviewed of 54 of the 93 patients reported as diabetics. One patient was diagnosed and reported as a diabetic on the basis of a fasting blood sugar of 156 mg./100 ml., but according to further records, had eaten a meal shortly before the test which was never repeated as recommended. Another person included as a diabetic because of a fasting blood sugar of 125 mg./100 ml. had a completely normal glucose tolerance test afterwards.

**Table 3. Results of first screening on all patients as reported to the Public Health Service, Nov. 15, 1958–Sept. 30, 1961**

Sex	Number of persons screened			Did not return for retest after positive screening	Positive screenees retested	Positive on retest and referred to clinic as new cases of diabetes	
	Total	Positive				Number	Percent
		Number	Percent				
Total ----- Male ----- Female -----	All screenees						
	7, 164	176	2. 5	22	154	77	1. 07
	3, 601	86	2. 4	13	73	27	. 75
	3, 563	90	2. 5	9	81	50	1. 38
	No family history of diabetes						
Male ----- Female -----	3, 326	76	2. 3	12	64	22	. 66
	2, 912	66	2. 3	6	60	34	1. 17
Male ----- Female -----	Family history of diabetes						
	275	10	3. 6	1	9	5	1. 81
	651	24	3. 7	3	21	16	2. 5

Seven of those reported came to the outpatient department with a chief complaint of polyuria and polydipsia. All had glycosuria, and two of these had been referred by a private physician because of glycosuria. There was one patient with boils and another with a gangrenous toe who had glycosuria reported in his record in 1954; tests showed both of these patients had glycosuria when seen by the examining physician in the clinic. One patient entered with cellulitis of one foot and had thirst and nocturia which suggested the diagnosis of diabetes to the examining physician before the screening result was reported.

Two patients had histories suggestive of diabetes, and glycosuria was reported by the laboratory at their previous outpatient department visits, 6 months previously for one patient and 18 months for the other. Neither had returned as instructed until they reported with other complaints at the time they were screened. Two patients later gave histories of having been told at an earlier date that they had "sugar in their urine," and one other had been previously told that he had "diabetes." Another had glycosuria reported in the old hospital record, two had previously elevated fasting blood sugars, and two with family histories of diabetes had positive glucose tolerance tests 10 years before the screening.

## Discussion

Diabetic screening programs have been held in many places. The yield has varied from 0 to 12 percent depending on the method used and the characteristics of the population screened,

as reported in an unpublished study conducted by the Division of Chronic Diseases, Public Health Service, and by other investigators (2,3). In this program using the clinitron, 1.07 percent of those patients initially screened and a total of 1.3 percent of those screened were eventually reported as diabetics. We do not know the percentage of outpatients more than 20 years of age who were screened during this period, but 4,470 hospital outpatients were screened over the 34½-month interval. The hospital has 51,000 outpatient visits a year, but the exclusion of persons under 20 and the number of multiple visits greatly reduced the number of patients eligible to be screened.

The instrument used gives results in 5½ minutes and has a capacity of 120 samples per hour. Because the machine was not being used optimally, an attempt was made to screen blood donors at a community blood bank, and an additional 2,247 screenees were obtained there. The blood donors were a relatively younger age group with 1,637, or 73 percent, being under age 45, which reduced the yield of the entire program. The blood donors are a transient population, and of the 22 people who screened positive and did not return for rescreening, 8 were blood donors. It is not known if these people sought followup elsewhere.

The increased incidence in older age groups, in females, and in patients with family histories of diabetes is consistent with other casefinding programs (3,4).

The fact that the rescreening was done on a fasting specimen probably decreased the sensitivity of the screening as evidenced by a lower yield than programs with rescreening at a specific postprandial interval (2,3), and by the 10 additional diabetics diagnosed by retesting those who originally screened positive and rescreened negative. However, it is not known if initially rescreening these particular 10 patients at 1 or 2 hours after a test meal would have resulted in an earlier diagnosis. Six of the people who initially screened negative rescreened positive and had a diagnosis of diabetes reported at a later date. No attempt was made to examine hospital records of those who screened negative for evidence of past or subsequent diabetes.

Because most of the people screened were

**Table 4. Results of screening program by age group, Nov. 15, 1958–Sept. 30, 1961**

Age group (years)	Number screened	Diabetics diagnosed after first screening		Total diabetics diagnosed	
		Number	Percent	Number	Percent
Under 45-----	4, 335	14	0. 32	17	0. 39
45-64-----	1, 806	31	1. 66	35	1. 93
65 and over----	1, 023	32	3. 1	41	4. 0
Total-----	7, 164	77	1. 07	93	1. 3

hospital patients, their records could be examined to see the influence the screening program had in discovering new cases of diabetes and in bringing previously diagnosed cases under care. It was also of interest to gain some idea of the number of cases in which screening was not necessary for the diagnosis; that is, cases in which the diagnosis was obvious clinically or had been made without knowledge of the screening results.

Prior to being screened all people denied a history of diabetes. Most people do not know their entire medical history, and what they do know certainly reflects what their physician feels is significant and what he chooses to tell them. In most screening programs adequate past medical records and followup are unavailable. Although this study group was primarily a hospital population and the screenees were supposedly being seen for another medical problem, the results of this study suggest how accurate or inaccurate are data obtained and reported from the populations screened in other diabetes detection programs.

The records of 54 patients diagnosed and reported as diabetics as a result of the screening were reviewed (table 5). Two patients did not have confirmed diabetes on review of their records. Ten had signs and symptoms indicative enough of diabetes that the diagnosis would have been suggested to the physician before the screening results were known. All of these patients had glycosuria. Ten other

patients had previous evidence of diabetes in their hospital records and might be considered as patients brought back to medical attention. This information in the records was not available to those who did the screening. It is not known whether past laboratory evidence of diabetes as glycosuria or hyperglycemia was not noted by the physician who had requested the urine or blood test or was felt to be not significant.

The remaining 32 records revealed no history or clinical evidence of diabetes, and these patients, who were attending the clinic for some other problem, appeared to have newly discovered cases.

Perhaps some additional details concerning several of these 32 patients should be mentioned. One patient who was reported as positive was screened the day that she was admitted to the hospital with terminal cancer of the breast and died within 11 days. She also had glycosuria on her admission urinalysis which is a routine hospital procedure. Two patients were diagnosed as diabetics on the basis of a 3-hour postprandial blood sugar of 175 and a 4-hour postprandial blood glucose of 174; neither had any record of glycosuria. These patients weighed 212 lbs. and 314 lbs., respectively, and are described as obese, uncooperative, and unreliable. One might wonder if such patients who claim 3 or 4 hours fasting in the middle of the day should have better documented diagnoses.

**Table 5. Effect of reported positive screening on initiation of therapy in the 54 patients<sup>1</sup> whose records were reviewed**

Therapy	Obvious clinical diagnosis or diagnosis made without results of screening	Previous evidence for diagnosis but screened patient returned to medical attention	New diagnosis	Total	
				Number	Percent
Insulin.....	9	3 ( <sup>32</sup> )	9 ( <sup>37</sup> )	12	29
Oral medication.....	1	2 ( <sup>31</sup> )	7 ( <sup>34</sup> )	9	21
Diet <sup>2</sup> .....		1	4	5	12
No treatment.....		3	8	11	26
Unknown.....		1	4	5	12
Total.....	10	10	32	42	100

<sup>1</sup> 2 patients did not have diabetes confirmed in the followup.

<sup>2</sup> More patients were prescribed low-calorie diets to lose weight than were given regimen designated as diabetic diet.

<sup>3</sup> Number showing repeated glycosuria while blood sugar was being brought under control.

Taking into account such patients, the actual yield of diabetics who were diagnosed or returned to followup as a result of the screening should probably be almost one-fourth less than the number reported.

The records were also examined to see how many patients received treatment and were followed for diagnosis (table 5). All patients with obvious clinical diabetes were put on insulin or oral hypoglycemic agents. Of the remaining 42 patients, 21 were treated with hypoglycemic agents. At least 14 of these 21 showed repeated glycosuria while being regulated. It is not known whether they had glycosuria at the time their blood was screened. Five patients were prescribed diets, usually reducing diets and not specifically designated as diabetic diets. These patients had been encouraged for varying periods of time prior to the screening to limit their caloric intake. Eleven (26 percent) of the patients received no treatment, and most of the records showed no evidence of subsequent concern with the disease by reference to symptoms, urinalyses, or blood tests. It is interesting in this regard that Clark and co-workers (5) found that there was no consistency between the level of blood sugar observed in a routine screening and the physician's decision to diagnose diabetes, with some diagnosing diabetes at 110 mg./100 ml. and others not considering 150 mg./100 ml. as diagnostic and not noting it on the record or considering hypoglycemic therapy. In recording a diagnosis of diabetes, initiating therapy, or changing therapeutic regimens, relatively little attention seems to be paid to minimal or even moderate hyperglycemia without glycosuria (5-8).

### Summary

During 34½ months of screening hospital outpatients and blood donors at an Iowa county hospital, using a blood sugar test, a total of 93 patients, or 1.3 percent of the 7,164 screened,

were diagnosed as diabetic. The results showed an increased yield of diabetics in the older age groups, in females, and in those with a family history of diabetes, findings similar to those in other programs.

The data suggest that a higher yield might have been obtained if positives had been re-screened with a glucose tolerance test or a post-prandial blood glucose at a specific time rather than a fasting blood glucose determination.

A part of the group reported as diabetics probably would have been so diagnosed without screening. The data obtained from subjects as to the past evidence of diabetes in those screened may be incorrect; a significant number of cases found were rediagnosed cases brought back to medical attention rather than new cases.

Not all patients screened and diagnosed as having diabetes mellitus received hypoglycemic therapy or were subsequently followed for the disease.

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